

Childhood Apraxia of Speech:
Differential Diagnoses, Treatment
Planning, and Evidence-Based
Practice.



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What is apraxia?

Childhood apraxia of speech (CAS) is a neurological childhood (pediatric) speech sound disorder in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits (e.g., abnormal reflexes, abnormal tone). CAS may occur as a result of known neurological impairment, in association with complex neurobehavioral disorders of known or unknown origin, or as an idiopathic neurogenic speech sound disorder. The core impairment in planning and/or programming spatiotemporal parameters of movement sequences results in errors in speech sound production and prosody. - ASHA 2007

CAS simulation

As a favor, half the staff gave their gruff boss a vase of five fragrant flowers.

It's difficult for Dave to verify several flavors of food when he has a fever.

Features that are shared with other speech sound disorders:

- Slow development of speech
- Reduced phonetic or phonemic inventories
- Multiple speech sound errors
- Reduced accuracy of consonant production
- Unintelligibility

(McCabe et al., 1998)

Characteristics that are more likely to be seen in children with CAS:

- Difficulty sequencing and ordering articulatory movements for speech
- Increased errors in longer, more complex word shapes
- Vowel errors
- Reduced vowel inventory
- Inconsistency of errors across repeated productions
- Unusual and atypical speech error patterns
- Speech regression
- Groping
- Differences in performance of automatic vs. volitional activities

Children who are at risk for CAS may have exhibited the following as an infant:

- Limited babbling
- Reduced vocal play
- Limited phonemic diversity in their babbling
- Reduced prosody (rise and fall contours) in their babbling

Children at-risk for CAS may exhibit the following as a young child:

- Measurable discrepancy between receptive and expressive language skills
- Expressive language skills being marginally delayed
- Late or slow development of speech
- Reduced ability or desire to imitate speech
- Good communicative intent, but fail to be understood

Speech production of children that are likely to have CAS

- Reduced phonemic repertoire
- Highly unintelligible speech
- Difficulty stringing and sequencing speech sounds together to produce words and word shapes
- Inconsistent errors
- Atypical and unusual error patterns
- May speak predominantly in vowels
- Increase in speech errors as performance load increases
- Difficulty with prosodic aspects of speech

Differential Diagnosis

- Articulation Disorder
- Developmental Phonological Disorder
- Dysarthria
- Intellectually Disabled
- Syndromes and genetic factors

Articulation Disorder

- Errors in manner and place of articulation
- Consistent errors
- Substitutions (/w/ for /r/), distortions (e.g. lateral lisp)
- May have weakness of speech musculature
- No difficulty with vowel productions
- Deletion of the final consonant more likely
- Normal prosody of speech
- Normal voice and resonance

Developmental Phonological Disorder

- Consistent, ruled governed errors grouped in descriptive categories
- Consistent errors as length and complexity of the utterance increases
- Ability to sequence strings of sounds together, although not accurately
- No weakness or incoordination of speech musculature
- No (or very minimal) difficulty with vowel productions
- Deletion of the final consonant more likely
- Normal prosody of speech
- Normal voice and resonance

Dysarthria

- Weakness and poor coordination of the speech musculature
- Slow, inaccurate speech (distortions)
- Reduced range of motion
- Decreased speed of speech movements
- Difficulty with involuntary motor control for mastication, sucking, swallowing etc.
- Consistent articulation errors
- Imprecise connected speech
- Drooling or poor saliva control
- Monopitch and monoloudness may occur
- Hoarse vocal quality and resonance problems (hypernasality)
- Speech productions tend to improve when child increases their volume

Intellectually Disabled

- Below average intelligence
- Delays in both receptive and expressive language
- Low nonverbal intelligence measures
- Speech is delayed but is around the same level as their cognitive abilities
- Expectations of motor speech skills are in line with the child's overall delays
- Motor speech disorder is secondary to global problem

Syndromes and genetic factors

- Down syndrome - one study suggests that at least 15% and likely more have apraxia of speech. (Kumin 2006)
- CAS can be present secondary to a genetic condition or syndrome.
- KE family: foxp2
- Autism - prevalence studies currently underway

How young can a child be diagnosed with CAS?

- It is not the age of the child that dictates whether or not practitioners can make an accurate diagnosis.
- The child must demonstrate the intent to communicate and have some level of verbal skill and verbal speech productions.

“Ready” for speech therapy?

- Willingness to attempt imitation targets and understand the *concept* of imitation
- Be actively engaged in therapy
- Be able to attend to a therapist-directed activity for a few minutes
- Attend to the therapist’s face long enough to watch and imitate her productions
- Joint attention
- Turn-taking skills
- Show cooperative, on-task behavior the majority of the time
- Engage in play and therapy activities with the therapist, not just with mom and dad
- Show basic communicative intent

Where to start

- Start with the sounds the child can already produce.
- Developmental articulation norms of acquisition should not determine which sounds to work on first.
- Build sound sequences from what the child has in their phonetic repertoire.

What if child has hardly any sounds?

- Then start with sounds according to typical developmental acquisition.
- These sounds are very visual such as /p/, /b/, /m/.
- Frequently occurring sounds that have the highest impact on speech intelligibility include /t/, /d/, and /n/

Sample Child

- 90% accuracy
 - b, m, n, d, h, w
 - ee, u, oo, o, a, i_e, o_e
- Less than 40% accuracy
 - p, t, η, sh,
- 0% accuracy
 - k, g
- words
 - mama, dada, bah, moo, no, up (cup), at (hat), od (dog), ine (mine), ie (hi), u (up)

Recommended Plan

- CV/VC syllables with mastered sounds
- Establish a core vocabulary and social words
- Increase accuracy for sounds that are inconsistent in isolation and CV/VC syllables
- CVCV words and CVC words with sounds in child's repertoire
- Increase production of pure vowels and diphthongs
- /k/ and /g/ in isolation

Get moving!!!

The focus of treatment must be teaching the *movement patterns* from one articulatory posture to the next, establishing accurate motor planning and programming, and ultimately habituation of these correct movements.

Principles of Motor Learning

The PML govern several key aspects in treatment approaches for motor speech disorders. These principles provide guidance for:

- » Practice amount
- » Practice distribution
- » Practice variability
- » Practice schedule
- » Feedback
- » Rate of motor movement

What is motor learning?

“Motor learning refers to a set of processes associated with practice or experience leading to relatively permanent changes in the capability for movement.”

(Schmidt, R.A., & Lee, T.D., 2005).

Your decisions make a difference!

- Conditions of practice make a difference in therapy outcomes.
- Some conditions may yield better motor performance within a single therapy session.
- Other conditions result in better retention, or motor learning.

Which is better?

Motor performance (achieving accurate productions for that therapy session)

or

Motor learning (retaining and transferring the skill)

Practice Amount

- A large number of practice trials provides more opportunities to rehearse the correct movement patterns for speech
- Performing 80 trials in a given session is better than only performing 20 trials
- Reinforcement activities should be brief

Small vs. large number of trials
→ More is better for motor learning

Practice Distribution

mass vs. distributed practice

- Mass practice is focusing on one specific target and practicing it over and over again in a given session.
- "I want"
- Distributed practice would involve using a variety of target speech movements or utterances in a given session.

mass vs. distributed practice
→ distributed is better for motor learning

Practice Distribution

- It can also relate to amount of treatment time per week: one 90-minute session per week (mass practice) vs. four 20-minute sessions per week (distributed practice).
- For children with CAS, it is better to provide three to five individual sessions per week compared to a less intensive model of only one to two sessions per week.

Practicing a variety of target trials over a longer period of time leads to better motor learning, although it will take longer to get accurate speech productions.

Practice Variability

constant vs. variable

- **constant practice:** practicing the same target, in the same context (i.e. /p/ in syllable initial position: *pi, pa, pu, po*).
- **variable practice:** practicing various targets in different context (i.e. /p/ /k/ and /d/ in syllable initial and final position: *pa, ik, du, eed, op ak*).

Variable Practice

- Variable practice benefits speech motor learning.
- Select stimuli that are variable and practice motor movements across different conditions and contexts.
- This variability can be with different target sounds in different positions, or even varying the prosodic aspects (i.e. stress and tone) of the target.

Constant vs. variable practice?

→ Variable practice better for motor learning

However, in the early stages of therapy or if the child has severe motor planning problems, constant practice might be more beneficial to start.

Practice Schedule

blocked vs. random practice

How do you organize and structure the target stimuli within a session?

- **Blocked practice** is practicing one target stimuli for a large number of trials within a practice block. One specific target stimuli is repeatedly practiced in a block before moving on to the next target stimuli.
Blocked practice: [AAA...][BBB...][CCC...]
- **Random practice** uses multiple randomized targets within a practice block.
Random practice: [BCA...][ACB...][BAC...]

Which is better?

Motor learning literature suggests that blocked practice yields better motor performance while random practice is better for learning parameters.

(Adams & Page, 2000; Lee, et al., 1985; Shea, et al., 1990)

Feedback

- Feedback type:
 - knowledge of performance (KP)
 - Giving specific feedback such as "put your lips together when you say, *pop*."
 - knowledge of results (KR)
 - General feedback such as "correct "or "incorrect."

Which is better?

- Both KP and KR seem to be effective.
- If a speech movement is novel or complex, KP might be better.
- Giving the child specific feedback in the initial stages of therapy is advised.
- Giving KR feedback later in therapy may be more beneficial, allowing the individual an opportunity to evaluate their own errors and possibly self-correct.

Feedback frequency:

high vs. low feedback frequency

- low frequency feedback results in better accuracy at retention.
- learners may become too dependent on feedback after every trial and not develop an internal feedback process.
- you don't have to evaluate your own productions if someone is doing it for you.

→ Low frequency better for motor learning

Feedback (continued)

- Higher frequency feedback is particularly important early on in treatment and with more severe cases.
- As treatment evolves, lower frequency feedback is recommended to avoid reliance on this feedback.

Feedback timing

immediate vs. delayed feedback

How long after a child's production should we wait before providing feedback?

- Studies of motor learning reveal that the use of delayed feedback enhances learning compared to immediate feedback.
- Waiting several seconds before giving feedback may allow processing time for the individual to internally evaluate their speech movement and consequence of their own production.

Feedback timing (continued)

- By giving feedback immediately, we may be interrupting that sensory motor feedback loop and hindering the development of that neural process.
- Delayed feedback is better for motor learning.

Rate of motor movement

- Slowing the rate of production will increase motor learning and accuracy.
- Slowing the rate facilitates proprioceptive processing.
- This gives the child more time to attend to sensory motor feedback (i.e. feeling the movement).

Some Treatment Methods:

- The Speech-EZ[®] Apraxia Program
- PROMPT[®]
- DTTC (Dynamic Temporal Tactile Cueing)
- Kaufman Approach
- Melodic Intonation Therapy

Any treatment approach should incorporate Principles of Motor Learning

Addressing Vowels

- Many children with severe apraxia of speech have difficulty with vowel production.
- These vowel errors are commonly vowel distortions rather than vowel substitutions.
- Vowels carry the melodic content of the word and play a significant role in speech intelligibility.

- Vowels should be addressed as soon as the child begins treatment.
- Your vowel inventory will guide you in determining what CV, VC, and CVCV forms to use in your initial stimulus set.
- Always include vowels that the child is stimuable for in your stimulus set.
- Begin working on vowels starting with the corner vowels.

Building sound sequences

- advance to CV, VC, CVCV, and CVC movement patterns right away.
- establish a list of functional core vocabulary words or **word shapes**
- incorporate pseudo syllable drills into therapy.
 - Pseudo words facilitate literacy development

Techniques

- Remember to keep the movement gesture of the word fluid.
- Do not break up the word (i.e. p-ig or coo-kie). Prolong the word to allow for extra processing and motor planning time for the child to get their articulators in the correct configurations.
- Breaking up the word, particularly for multisyllabic words, can adversely affect prosody by placing equal stress on each syllable: ba-na-na.

Techniques

- **Coarticulation** is the overlapping or influence of adjacent articulations. The articulators will begin moving towards the position of the following sound anticipating the movement gesture.
 - anticipatory coarticulation: “tenth”
 - perseverative coarticulation: “cats” vs. “dogs”

Techniques

- “pin” and “pool”: we realize that the preparatory movement gesture for each word is very different, although they begin with the letter “p”.
- “moo” Position the lips for “oo” first. Encourage a lip-rounded /m/.
- /l/ and /r/ blends
- when helping children prepare for the correct articulatory postures for syllables and words, assist the child in producing allophonic variations.

Addressing Prosody

- Therapy should incorporate developing accurate prosody skills from the very beginning.
- Examples:
 - Omitting the weak syllable (unstressed syllable). For example “banana” is pronounced as “nana”.
 - Overstress the weak syllable in a word resulting in equal syllable stress or inappropriate syllable stress; “baby” incorrectly pronounced as “baBY”.

It is tempting to emphasize the omitted syllable to make sure the child “hears” what they left out: *BAnana*. A common mistake practitioners and parents make is to model inappropriate syllable stress and prosody when trying to correct the child. **Do not encourage accurate articulation at the expense of prosody.**

Literacy Development

- Children with CAS are at risk for a persistent reading and spelling disorder in addition to their spoken communication difficulties.
- Difficulty with perceptual tasks might be one of the underlying causes of various speech sound disorders, including CAS.
- Addressing auditory processing and speech perception skills in therapy increases phonological awareness, which is critical for literacy development.

Literacy Development

- Rhyme awareness
- Phonemic awareness
- Segmenting and blending
- Phonological manipulation
- Auditory memory

Thank You For Attending!!!

Q and A

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